WHAT IS CLAIMED IS:

1. A method for sensing a sample employing a profiler, said profiler having a stylus sensor assembly with an arm rotatable about a pivot and a controller controlling a force acting on the arm, said method comprising the steps of:

(a) positioning a sensing tip above one location of the sample;

(b) reducing a distance between the sample and a sensing tip without substantially moving the tip and the sample laterally relative to each other and without substantially rotating the arm about said pivot, until the tip touches the sample;

(c) measuring data related to a height of the sample surface with the tip stationary and in contact with the sample;

(d) increasing a distance between the tip and the sample to lift the tip off the sample;

(e) causing lateral relative motion between the sensing tip and the sample and positioning the tip so that the tip is above a location of the sample adjacent to and spaced apart from said one location; and

(f) repeating steps (b) through (e) at a plurality of locations of the sample to obtain an image of the sample.

2. The method of claim 1, further comprising a step (b1) of determining whether the tip touches the sample by comparing to a threshold value a distance rotated by the tip about the pivot caused by the sample.

3. The method of claim 2, further comprising setting the threshold value to not more than about 500 nm.

4. The method of claim 1, wherein step (d) increases the distance between the tip and the sample to a value greater than an expected maximum height variation of the sample surface.

5. The method of claim 2, said method further comprising:

sensing when a force between the tip and the sample reaches a preset value; and

maintaining the force between the tip and the sample substantially at said preset value when the tip is rotated by the sample until the distance rotated is substantially equal to said threshold value.

6. The method of claim 5, said profiler comprising at least one moving stage for moving the tip in steps (a), (b), (d), (e), wherein said steps (a), (b), (d), (e) are performed by the at least one stage, further comprising detecting when the distance that the tip is rotated by contact with the sample is substantially equal to said threshold value.

7. The method of claim 6, further comprising causing the moving stage to stop moving the tip when the distance that the tip is rotated by contact with the sample is substantially equal to said threshold value.

8. The method of claim 1, wherein step (e) causes lateral relative motion for a distance in the range of about 1 nm to 50 mm.

9. The method of claim 1, said profiler comprising at least one moving stage for moving the tip in steps (a), (b), (d), (e), wherein said steps (a), (b), (d), (e) are performed by the at least one stage.

10. The method of claim 9, wherein said steps (a), (b) and (d) are performed without the at least one stage substantially moving the tip and the sample laterally relative to each other.

11. The method of claim 9, said data in step (c) being measured by taking into account a distance moved by the at least one moving stage in step (b) and a distance rotated by the tip about the pivot when the tip touches the sample.

12. The method of claim 1, wherein said arm is constrained to substantially one degree of freedom, so that contact between the tip and the sample in step (b) causes the tip to rotate substantially without twisting.

13. The method of claim 1, wherein said increasing step (c) increases the distance between the tip and the surface to a constant value before lateral relative motion is caused in step (d).

14. A method for sensing a feature on a surface of a sample employing a sensing tip, said method comprising the steps of:

(a) positioning the sensing tip above one location of the surface;

(b) reducing a distance between the surface and a sensing tip without substantially moving the tip and the surface laterally relative to each other until either the tip or the surface has traveled, or the tip and the surface together have traveled in aggregate, by a preset distance without contacting the surface, or until the tip touches the surface;

(c) increasing a distance between the tip and the surface without substantially moving the tip and the surface laterally relative to each other until such distance is substantially equal to a predetermined value, said predetermined value being such that after step (c) the tip is higher in elevation than another location of the surface adjacent to and spaced apart from said one location;

(d) causing lateral relative motion between the sensing tip and the surface and positioning the tip so that the tip is above said another location; and

(e) repeating steps (b) through (d) at a plurality of locations of the surface to find or measure the feature.

15. The method of claim 14, further comprising finding said determined value so that after step (c) the tip is higher in elevation than another location of the surface adjacent to and spaced apart from said one location.

16. The method of claim 15, wherein said finding includes measuring data related to height of the surface prior to step (c) and predicting from such data an elevation of said another location.

17. The method of claim 16, wherein said predicting includes curve fitting said data related to heights of the surface at a plurality of locations and extrapolation.

18. The method of claim 16, wherein said sample surface is inclined and wherein said predicting includes estimating a slope of the sample surface.

19. The method of claim 15, wherein said finding step includes providing height information concerning a target area of the sample surface, said target area containing the one and the another location of the surface so that when said distance between the tip and said surface is increased to said predetermined value in step (c), the tip is at a higher elevation than all locations within the target area of the surface.

20. The method of claim 19, wherein said finding includes measuring data related to the height of the surface at a plurality of sampling locations of the surface within the target area.

21. The method of claim 20, wherein said measuring includes:

(f) positioning the sensing tip above a first sampling location of the surface within the target area;

(g) reducing a distance between the surface and a sensing tip without substantially moving the tip and the surface laterally relative to each other until either the tip or the surface has traveled, or the tip and the surface together have traveled in aggregate, by a preset distance without contacting the surface, or until the tip touches the surface;

(h) increasing a distance between the tip and the surface without substantially moving the tip and the surface laterally relative to each other until such distance is substantially equal to a second predetermined value, said second predetermined value being such that after step (h) the tip is higher in elevation than all locations of the surface within the target area;

(i) causing lateral relative motion between the sensing tip and the surface and positioning the tip so that the tip is above another sampling location within the target area of the surface; and

(j) repeating steps (g) through (i) at said plurality of sampling locations of the surface within the target area.

22. The method of claim 14, wherein said finding includes measuring data related to the height of the surface at 3 to 25 sampling locations of the surface within the target area.

23. The method of claim 14, wherein said causing step (d) causes lateral relative motion over a distance in the range of about 1 nm to 50 mm.

24. The method of claim 14, further comprising measuring a height of the surface with the tip stationary and in contact with the surface when the tip touches the surface.

25. The method of claim 14, wherein said predetermined value is not more than about 1 micron.

26. The method of claim 14, said sensing tip being that of a profiler, said profiler having an arm rotatable about a pivot and a controller controlling a force acting on the arm, wherein said steps (a), (b), (c) and (d) are performed without substantially rotating the arm about said pivot unless the tip is in contact with the surface.

27. The method of claim 14, further comprising a step (b1) of determining whether the tip touches the surface by comparing to a threshold value a distance moved by the tip caused by the surface.

28. The method of claim 27, further comprising setting the threshold value to not more than about 500 nm.

29. The method of claim 27, said method further comprising:

sensing when a force between the tip and the sample reaches a preset value; and

maintaining the force between the tip and the sample substantially at said preset value when the tip is moved by the sample until the distance moved is substantially equal to said threshold value.

30. The method of claim 29, said profiler comprising a controller controlling a force exerted by the tip against the surface, wherein said controller is used to perform the force sensing and maintenance.

31. The method of claim 14, wherein the feature is found in step (b) or step (e) when either the tip or the surface has traveled, or the tip and the surface together have traveled in aggregate, by said preset distance without contacting the surface.

32. The method of claim 31, wherein after the feature is found, step (b) is repeated in step (e) by reducing a distance between the surface and a sensing tip until the tip touches the surface, said method further comprising measuring data related to a height of the feature with the tip stationary and in contact with the surface when the tip touches the surface to obtain a profile or an image of the feature.

33. The method of claim 14, wherein when the tip touches the surface in step (b), in the immediately following step (c), the distance between the tip and the surface is increased by a first predetermined distance, and wherein when the tip does not touch the surface in step (b), in the immediately following step (c), the distance between the tip and the surface is increased by a second predetermined distance.

34. The method of claim 33, wherein said second predetermined value is substantially equal to said preset distance.

35. The method of claim 33, wherein said second predetermined value is larger than the first predetermined value.

36. The method of claim 14, wherein a target area of the sample surface has substantially two discrete heights, with portions of the surface in the target area at a lower first height and portions at a higher second height; and wherein step (a) positions the sensing tip above one location at the second height.

37. The method of claim 36, wherein step (b) reduces the distance between the surface and a sensing tip until the tip touches the surface at the first or the second height in the target area.

38. The method of claim 14, said method employing at least one moving stage for moving the tip in steps (b), (c), (d), wherein said steps (b), (c), (d) are performed by the at least one stage.

39. The method of claim 38, wherein said steps (a), (b) and (c) are performed without the at least one stage substantially moving the tip and the sample laterally relative to each other.

40. The method of claim 39, further comprising measuring data related to height of the surface, said data being measured by taking into account a distance moved by the at least one moving stage in step (b) and a distance moved by the tip relative to the stage caused by contact with the sample.

41. A method for sensing a high aspect ratio feature on a surface of a sample employing a sensing tip, said method comprising the steps of:

scanning the sensing tip across the surface; and

controlling a distance between the surface and the tip so that the tip contacts the surface intermittently, without substantially moving the tip and the surface laterally relative to each other when the tip and surface are in contact, wherein the tip does not penetrate said feature when scanning across the surface.

42. The method of claim 41, wherein said controlling includes reducing a distance between the surface and the sensing tip without substantially moving the tip and the surface laterally relative to each other until either the tip or the surface has traveled, or the tip and the surface together have traveled in aggregate, by a preset distance without contacting the surface or until the tip touches the surface.

43. The method of claim 42, wherein the feature is found when either the tip or the surface has traveled, or the tip and the surface together have traveled in aggregate, by said preset distance without contacting the surface.

44. The method of claim 43, further comprising, after the feature is found, measuring data related to a height of the feature with the tip stationary and in contact with the surface when the tip touches the surface to obtain a profile or an image of the feature.

45. The method of claim 42, further comprising measuring a height of the surface with the tip held in contact with the surface when the tip touches the surface.

46. The method of claim 45, further comprising, after the reducing:

increasing a distance between the sensing tip and the sample without substantially moving the tip and the surface laterally relative to each other; and

causing lateral relative motion between the sensing tip and the surface.

47. The method of claim 46, wherein said sample has a sloping surface, wherein said measuring measures data related to height of the surface at a plurality of locations of the surface; said method further comprising:

predicting a slope of the sample surface from said data; and

determining the distance that is increased so that the sensing tip will not contact the surface laterally during the lateral relative motion.

48. The method of claim 41, wherein said controlling causes the distance between the surface and the tip to increase to values not more than about 1 micron.

49. The method of claim 41, said sensing tip being that of a profiler, said profiler having an arm rotatable about a pivot and a controller controlling a force acting on the arm, wherein said scanning and controlling steps are performed without substantially rotating the arm about said pivot unless the tip is in contact with the surface.

50. The method of claim 49, further comprising determining whether the tip touches the surface by comparing to a threshold value a distance moved by the tip about the pivot caused by the surface.

51. The method of claim 50, further comprising setting the threshold value to not more than about 500 nm.

52. The method of claim 50, said method further comprising:

sensing when a force between the tip and the sample reaches a preset value; and

maintaining the force between the tip and the sample substantially at said preset value when the tip is moved by the sample until the distance moved is substantially equal to said threshold value.

53. The method of claim 41, said method further comprising positioning the tip above a location of the surface so that the tip will not come into lateral contact with the surface.

54. The method of claim 53, wherein said positioning includes providing height information concerning the surface.

55. The method of claim 54, wherein said providing includes measuring height of the surface at sampling locations of the surface in a dipping mode.

56. A method for sensing a surface of a sample employing a probe with a sensing tip, said method comprising the steps of:

(a) positioning the sensing tip above one location of the surface of the sample;

(b) reducing a distance between the surface and a sensing tip without substantially moving the tip and the surface laterally relative to each other until the tip touches the surface;

(c) measuring data related to a height of the sample surface with the tip in contact with the sample at a contact point;

(d) increasing a distance between the tip and the contact point of the surface without substantially moving the tip and the surface laterally relative to each other until such distance is substantially equal to a predetermined value;

(e) causing lateral relative motion between the sensing tip and the surface and positioning the tip so that the tip is above a location adjacent to and spaced apart from said one location; and

(f) repeating steps (b) through (e) at a plurality of locations of the surface to obtain an image of the surface;

said method further comprising step (e1) of determining whether the tip and the surface are in contact during step (d), wherein steps (b) through (e) are repeated in step (f) only after a determination that the tip and the surface are not in contact.

57. The method of claim 56, wherein step (a) positions the sensing tip without adequate prior information concerning extent of height variations of the surface to avoid lateral contact between the tip and the surface when the tip is scanned across the surface, and said lateral relative motion in step (e) is over a lateral distance less than about 100 nm.

58. The method of claim 57, further comprising step (e2) of increasing a distance between the tip and the sample without substantially moving the tip and the sample laterally relative to each other until such distance is substantially equal to the predetermined value when said determining step (e1) determines that the tip and the surface are in contact after step (d).

59 The method of claim 58, further comprising repeating steps (e1), (e2) until said determining step determines that the tip and surface are not in contact, wherein steps (b) through (e) are then repeated in step (f).

60. The method of claim 58, further comprising discarding the data measured when the tip remains in contact with the surface after step (d) and during steps (e1) and (e2).

61. The method of claim 56, wherein the sensing tip is that of a probe of a profiler or scanning probe microscope, step (e1) determines whether the tip and the surface are in contact by:

causing the probe to approach the surface; and

sensing whether the tip rises as soon as the probe is caused to approach the surface or whether the tip has moved by a threshold distance when the probe is caused to approach the surface.

62. The method of claim 61, further comprising setting the threshold value to not more than about 500 nm.

63. The method of claim 61, said probe being that of a profiler, said method further comprising:

sensing when a force between the tip and the sample reaches a preset value; and

maintaining the force between the tip and the sample substantially at said preset value when the tip is rotated by the sample about a pivot of the profiler until the distance rotated is substantially equal to said threshold value.

64. The method of claim 56, wherein said measuring measures data related to a height of the sample surface with the tip stationary and in contact with the sample at the contact point.

65. A method for sensing a high aspect ratio feature on a surface of a sample employing at least a first and a second sensing tips on a common probe, said method comprising the steps of:

scanning the first sensing tip across the surface with the first tip in contact with the surface until the feature is found; and

scanning the second sensing tip across the surface with the second tip in intermittent contact with the surface to measure the feature.

66. The method of claim 65, wherein the second sensing tip comprises a nanotube.

67. A scanning probe including a first and a second sensing stylus with known spatial relationship to each other, said stylus including a nanotube.

68. The probe of claim 67, said nanotube extending beyond the first sensing stylus.

69. A method for sensing a high aspect ratio feature on a surface of a sample employing at least one sensing tip on a probe, said method comprising the steps of:

scanning the at least one sensing tip across the surface with the tip in contact with the surface until the feature is found; and

scanning the at least one sensing tip across the surface with the tip in intermittent contact with the surface to measure the feature.

70. A method for sensing a high aspect ratio feature on a surface of a sample employing a sensing tip of a profiler or scanning probe microscope, said method comprising the steps of:

providing height information of the surface within a target area of the surface;

positioning the tip above one location of the surface in the target area using such information;

scanning the sensing tip across the surface; and

controlling a distance between the surface and the tip using said information during the scanning so that the tip contacts the surface intermittently and so that the tip does not contact the surface laterally when the tip is scanned across the surface.

71. The method of claim 70, wherein said controlling controls said distance so that the tip is scanned without substantially moving the tip and the surface laterally relative to each other when the tip and surface are in contact, wherein the tip does not penetrate said feature when scanning across the surface,

72. The method of claim 70, wherein said tip contacts the surface at a sequence of locations, wherein said providing includes measuring data related to the height of the surface at at least one location within a target area of the surface when the tip is in contact with the surface, and wherein said controlling controls the distance using said data so that the tip is raised to an elevation higher than the subsequent location of the surface in the target area in the sequence.

73. The method of claim 72, wherein said providing includes measuring data related to the height of the surface at a plurality of sampling locations within the target area of the surface.

74. The method of claim 73, wherein said controlling includes predicting from such data an elevation of the subsequent location of the surface in the target area in the sequence.

75. The method of claim 74, wherein said predicting includes curve fitting such data and extrapolation.

76. The method of claim 73, wherein said measuring includes:

(a) positioning the sensing tip above a first sampling location of the surface in the target area of the surface;

(b) reducing a distance between the surface and a sensing tip without substantially moving the tip and the surface laterally relative to each other until either the tip or the surface has traveled, or the tip and the surface together have traveled

in aggregate, by a preset distance without contacting the surface, or until the tip touches the surface;

(c) increasing a distance between the tip and the surface without substantially moving the tip and the surface laterally relative to each other until such distance is substantially equal to a second predetermined value, said second predetermined value being such that after step (c) the tip is higher in elevation than all locations of the surface within the target area;

(d) causing lateral relative motion between the sensing tip and the surface and positioning the tip so that the tip is above another sampling location in the target area; and

(e) repeating steps (b) through (d) at said plurality of sampling locations of the surface in the target area.

77. An apparatus for sensing a sample, comprising:

a senor assembly for sensing the sample, said assembly including a base portion and a movable portion, said movable portion including a sensing tip connected to the base portion, wherein a force applied to the tip caused by contact between the tip and the sample may cause the tip to move relative to the base portion;

one or more moving stage(s) causing a vertical relative motion between the assembly and the sample, thereby changing a distance between the assembly and the sample; and

a measurement controller computing a change in the distance between the sensing tip and the sample caused by a combination of the relative motion between the tip and the base portion of the sensor assembly and said vertical motion.

78. The apparatus of claim 77, said assembly comprising an arm rotatable about a pivot, said arm having a sensing tip, and a sensor sensing distance rotated by said sensing tip about the pivot; wherein the measurement controller computes

a change in the distance between the sensing tip and the sample caused by a combination of the rotation of the tip about the pivot and said vertical motion.

79. The apparatus of claim 78, further comprising a feedback path between the sensor and the moving stage(s), said path transmitting a signal representative of the distance moved by the tip caused by the surface, said one or more moving stage(s) controlling the vertical motion in response to said signal.

80. The apparatus of claim 79, said moving stage(s) having a motion controller controlling the vertical motion in response to the signal.

81. The apparatus of claim 80, wherein said motion controller causes the moving stage(s) to stop causing vertical motion between the profiler and the sample when the tip has moved by a distance substantially equal to a threshold value.

82. The apparatus of claim 78, further comprising a force controller controlling a force acting on the sensor assembly so that a preset force is applied by the tip to the sample when the tip is caused to move by the surface.